WAOH : Virtual Automotive HMI Evaluation Tool

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1 Introduction

Due to various features being available in the vehicle such as multimedia, the dashboard has become rather complicated. Therefore, an increased need for HMI(Human Machine Interface) research has arisen in the design creation process. However, there are issues such as design changes occurring even after the design is selected due to the initial evaluation being too simple to cover all of the requirements. Designers do not consider carefully HMI the during sketching phase and issues with designs are discovered too far along in the process. This study suggests an HMI simulation tool system based on projection to pre-evaluate an HMI prior to selecting specifications through virtual function implementation. This system evaluates each function of centerfacia through quantitative criteria such as performance time and distraction time. As a result, the objective of the system is to quickly analyze and validate designs through virtual means and find interface issues with a quantitative method.

2 System

The main system consists of a projector-camera module that projects an image onto the center stack area and captures finger movement. A colored fingertip pointer is connected to a wristband unit that houses a battery and Bluetooth module. A sensor can be attached anywhere that allows the user to evaluate the usability of physical knob. Computer monitors to manipulate interfaces and analyze data. An eye-tracker measures distraction time where the drivers attention has been taken off the road. The software not only gathers data, but can also analyze it in order to identify specific problems with a design and compare it to other designs. This tool is planned to be used in conjunction with driving simulators for more realistic interaction. Without the simulators, this tool can still be used anywhere. A desktop setup is a possible solution(Fig 1).
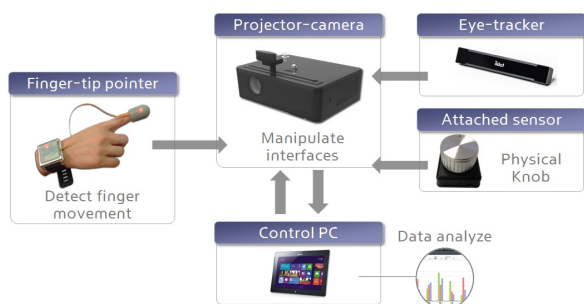

Figure 1: *WAOH system*

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In order to validate the system, a comparative experiment was conducted to verify similarity of operation between a real vehicle and the tool. The primary measurement was the performance time of radio, climate, media and navigation functions, and a t-test was used to analyze data. We verified that the tool we proposed in this study gives drivers an experience similar to a real car(Fig 2).
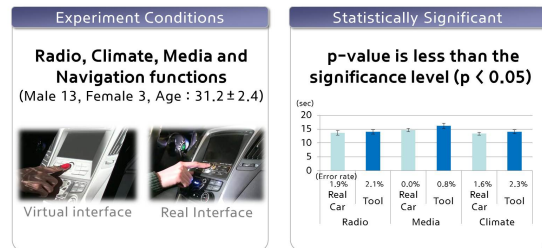

Figure 2: *System validation between real car and virtual interface*

3 Evaluation Process

The test process is based on NHTSA guidelines[NHTSA] for driving simulator usage. The experimenter sets up design elements with computer such as defining area and function.Subjects can interact with the interface. The tool gives visual and auditory feedback and gathers data such as performance time and distraction time. When the experiment is finished, the tool produces graphs, analyzes statistical significance, identifies specific problems with the design and compares the tested interface with previously tested designs(Fig 3).
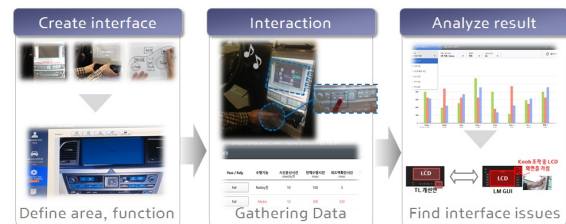

Figure 3: *Evaluation Process*

4 Vision

We created new methods allowing for the evaluation of automotive HMI through virtual function implementation. This system can be used to evaluate interface designs early in the development process.We believe that this tool provides great benefit: designers can start evaluation during the sketching phase and avoid difficult-to-solve problems later.

References

NHTSA. 2012. *Visual-manual NHTSA driver distraction guidelines for in-vehicle electronic devices*. National Highway Traffic Safety Administration (NHTSA), Department of Transportation (DOT).